How cells respond to high-gradient magnetic fields

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Mechanisms underlying cell response to magnetic fields have long been elusive. Nevertheless, several of the underlying mechanisms were identified for different types of cells exposed to a high-gradient magnetic field (HGMF) [1-3]. We present the results towards a fundamental understanding of the cell response to an HGMF, highlighting new directions for the study of living cell machinery: changing the membrane potential and probability of ion-channel on/off switching events by membrane magneto-mechanical stress, inhibition of cell division and suppression of cell growth by magnetic pressure, magnetically induced cell division, and membrane pore formation. We show how the magnetic gradient forces can drive the cell fate. In particular, we explain how stem cells make the fate decision during differentiation process in HGMFs. Timescales of cell response to HGMFs are dependent on the magnitude of the magnetic field gradient and vary from seconds to days [2]. Several hypotheses have been formulated to explain the time delay of the cell response to magnetic fields. An overarching mechanism related to the magnetic gradient forces now unifies these disparate models. By understanding the mechanisms and ways in which HGMFs can be utilized to induce the required cellular responses, we can begin to consider high-gradient magnetic fields as tiny non-invasive tools that can remotely alter the cell machinery, promising broad application potential in cell therapy, neurobiology and nanomedicine.

References:

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